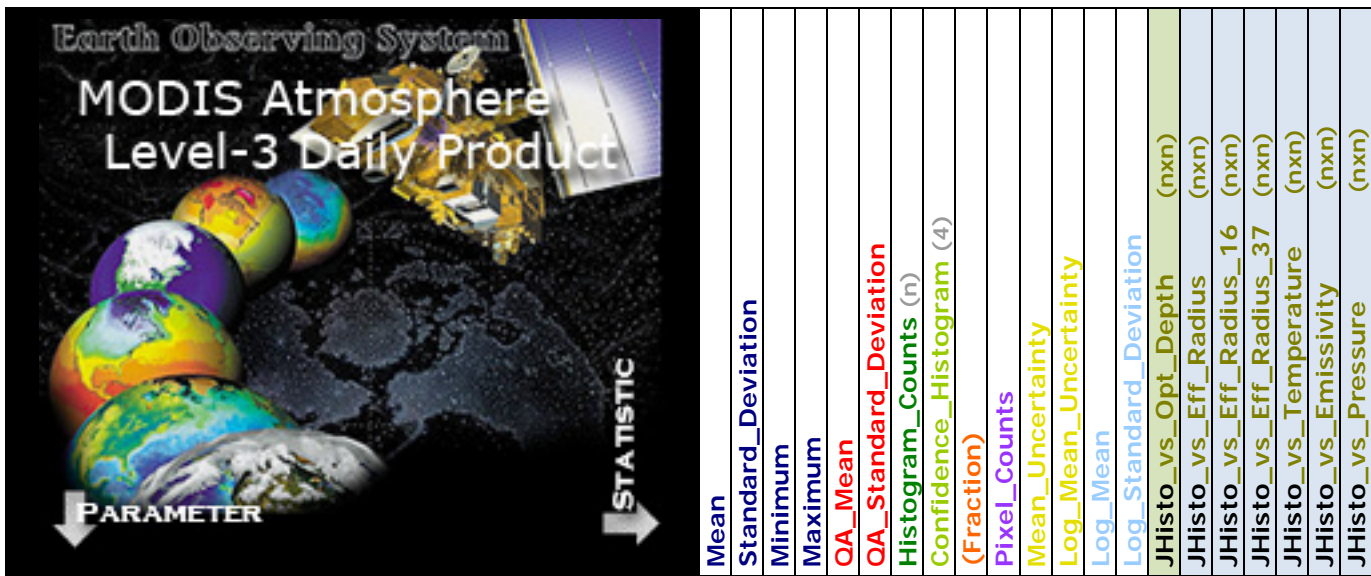


Earth Observing System MODIS Atmosphere Level-3 Daily Product																						
PARAMETER	STATISTIC	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4)	(Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)
		12. Cloud_Top_Temperature_Nadir_Night [*]		•	•	•	•						•									
13. Cloud_Effective_Emissivity [L/M/H JHisto 11x10]		•	•	•	•						•											•
14. Cloud_Effective_Emissivity_Day [*]		•	•	•	•						•											•
15. Cloud_Effective_Emissivity_Night [*]		•	•	•	•						•											•
16. Cloud_Effective_Emissivity_Nadir [L/M/H JHisto 11x10]		•	•	•	•						•											•
17. Cloud_Effective_Emissivity_Nadir_Day [*]		•	•	•	•						•											•
18. Cloud_Effective_Emissivity_Nadir_Night [*]		•	•	•	•						•											•
19. Cloud_Fraction [L/M/H JHisto 12x10]		•	•	•	•						•											•
20. Cloud_Fraction_Day [*]		•	•	•	•						•											•
21. Cloud_Fraction_Night [*]		•	•	•	•						•											•
22. Cloud_Fraction_Nadir [L/M/H JHisto 12x10]		•	•	•	•						•											•
23. Cloud_Fraction_Nadir_Day [*]		•	•	•	•						•											•
24. Cloud_Fraction_Nadir_Night [*]		•	•	•	•						•											•
25. Cloud_Top_Height [L/M/H JHisto 18x3]		•	•	•	•																	•
26. Cloud_Top_Height_Day [*]		•	•	•	•																	•
27. Cloud_Top_Height_Night [*]		•	•	•	•																	•
28. Cloud_Top_Height_Nadir [L/M/H JHisto 18x3]		•	•	•	•						•											•
29. Cloud_Top_Height_Nadir_Day [*]		•	•	•	•						•											•
30. Cloud_Top_Height_Nadir_Night [*]		•	•	•	•						•											•
31. Cirrus_Fraction_Infrared [denom. includes clear sky in C6]										•	•											
32. High_Cloud_Fraction_Infrared [denom. includes clear]										•	•											
33. Cloud_Phase_Infrared							•															

Earth Observing System MODIS Atmosphere Level-3 Daily Product																					
	PARAMETER	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4) (Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)
34.	Cloud_Phase_Infrared_Day							•											D		•
35.	Cloud_Phase_Infrared_Night							•											D		•
36.	Cloud_Top_Pressure_1km_Nadir_Day [sample vs. avg.]																				•
37.	Cloud_Top_Pressure_1km_Nadir_Night [sample vs. avg.]																				•
38.	Sunglint_Fraction_Day [daytime only phenomenon]								•	•											
39.	Snow_Fraction_Spectral_Under_Thin_Clouds_Day								•	•											
40.	Snow_Fraction_Ancillary_Under_All_Clouds_Night								•	•											
41.	Ocean_Fraction_Day								•	•											
42.	Ocean_Fraction_Night								•	•											
43.	Coast_Fraction_Day								•	•											
44.	Coast_Fraction_Night								•	•											
45.	Desert_Fraction_Day								•	•											
46.	Desert_Fraction_Night								•	•											
47.	Land_Fraction_Day								•	•											
48.	Land_Fraction_Night								•	•											
Cloud Optical Properties [PCL:Partly Cloudy Day:SolarZA≤81.3731°]																					
<i>(Primary 2.1 Retrieval)</i> D = SDS in D3 only (not in E3/M3)																					
01.	Cloud_Optical_Thickness_Liquid	•	•	•	•			•			•	•	•	•					•		•
02.	Cloud_Optical_Thickness_Ice	•	•	•	•			•			•	•	•	•					•	D	•
03.	Cloud_Optical_Thickness_Undetermined	•	•	•	•								•	•							
04.	Cloud_Optical_Thickness_Combined	•	•	•	•								•	•							
05.	Cloud_Optical_Thickness_PCL_Liquid	•	•	•	•			•			•										

Earth Observing System MODIS Atmosphere Level-3 Daily Product																				
PARAMETER	STATISTIC																			
	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4) (Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)
06. Cloud_Optical_Thickness_PCL_Ice	•	•	•	•			•			•				•						
07. Cloud_Optical_Thickness_PCL_Undetermined	•	•	•	•																
08. Cloud_Optical_Thickness_PCL_Combined	•	•	•	•																
09. Cloud_Optical_Thickness_ISCCP ⁸																			•	
10. Cloud_Optical_Thickness_PCL_ISCCP ⁸																			•	
11. Cloud_Effective_Radius_Liquid	•	•	•	•			•			•								•		D
12. Cloud_Effective_Radius_Ice	•	•	•	•			•			•								•		D
13. Cloud_Effective_Radius_Undetermined	•	•	•	•																
15. Cloud_Effective_Radius_PCL_Liquid	•	•	•	•						•										
16. Cloud_Effective_Radius_PCL_Ice	•	•	•	•						•										
17. Cloud_Effective_Radius_PCL_Undetermined	•	•	•	•																
18. Cloud_Water_Path_Liquid	•	•	•	•			•			•										
19. Cloud_Water_Path_Ice	•	•	•	•			•			•										
20. Cloud_Water_Path_Undetermined	•	•	•	•																
22. Cloud_Water_Path_PCL_Liquid	•	•	•	•			•			•										
23. Cloud_Water_Path_PCL_Ice	•	•	•	•			•			•										
24. Cloud_Water_Path_PCL_Undetermined	•	•	•	•																
25. Cloud_Phase_Optical_Properties [L, I, U] [Cld+PCL] [S+F?]																		•		
26. COP_Phase_Cloudy [3 cats: Liq, Ice, Undet] CSR=0 [Succ+Fall]																				D
27. COP_Phase_Partly_Cloudy [Liq, Ice, Undet] CSR=1.3 [S+F]																				D
28. COP_Phase_CloudMaskClear [Cloud Mask Clear] CSR=0																				D
29. COP_Phase_RestoredToClear [Restored To Clear] CSR=2																				D



(Primary Successful Cloud Retrieval Fraction)

30. Cloud_Retrieval_Fraction_Liquid [denom. incl. fail in C6]																				
31. Cloud_Retrieval_Fraction_Ice [denom. incl. fail in C6]																				
32. Cloud_Retrieval_Fraction_Undetermined [?]																				
33. Cloud_Retrieval_Fraction_Combined [?]																				
34. Cloud_Retrieval_Fraction_PCL_Liquid [?]																				
35. Cloud_Retrieval_Fraction_PCL_Ice [?]																				
36. Cloud_Retrieval_Fraction_PCL_Undetermined [?]																				
37. Cloud_Retrieval_Fraction_PCL_Combined [?]																				

(Primary Retrieval Single-Layer Clouds only)


01. Cloud_Optical_Thickness_1L_Liquid ⁴	•	•	•	•			•													D
02. Cloud_Optical_Thickness_1L_Ice ⁵	•	•	•	•			•													D
03. Cloud_Effective_Radius_1L_Liquid	•	•	•	•			•													
04. Cloud_Effective_Radius_1L_Ice	•	•	•	•			•													
05. Cloud_Water_Path_1L_Liquid	•	•	•	•			•													
06. Cloud_Water_Path_1L_Ice	•	•	•	•			•													
07. Cloud_Phase_Optical_Properties1L																				D

(Single-Layer Cloud Fraction)

08. Cloud_Retrieval_Fraction_1L_Liquid [denom. incl. fail]																				
09. Cloud_Retrieval_Fraction_1L_Ice [denom. incl. fail]																				

(Multi-Layer Cloud Fraction)

Earth Observing System MODIS Atmosphere Level-3 Daily Product																							
PARAMETER	STATISTIC	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4)	(Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)	
01. Cloud_Retrieval_Fraction_ML_Liquid [denom. incl. fail]																							
02. Cloud_Retrieval_Fraction_ML_Ice [denom. incl. fail]																							
03. Cloud_Retrieval_Fraction_ML_Undetermined [*]																							
04. Cloud_Retrieval_Fraction_ML_Combined [*]																							
<i>(Ratio of Multi-Layer Clouds to All-Layer Clouds by Phase)</i>																							
05. ML_Ratio_Liquid [prev. Fraction]																							
06. ML_Ratio_Ice [prev. Fraction]																							
07. ML_Ratio_Undetermined [prev. Fraction]																							
08. ML_Ratio_Combind [prev. Fraction]																							
<i>(Supplementary 1.6/2.1 Retrieval) vs. Re1621</i>																							
01. Cloud_Optical_Thickness_1621_Liquid ⁶		•	•	•	•																		
02. Cloud_Optical_Thickness_1621_Ice ⁷		•	•	•	•																		
03. Cloud_Effective_Radius_1621_Liquid		•	•	•	•																		
04. Cloud_Effective_Radius_1621_Ice		•	•	•	•																		
05. Cloud_Water_Path_1621_Liquid		•	•	•	•																		
06. Cloud_Water_Path_1621_Ice		•	•	•	•																		
07. Cloud_Retrieval_Fraction_1621_Liquid [denom incl. fail]																							
08. Cloud_Retrieval_Fraction_1621_Ice [denom incl. fail]																							
09. Cloud_Optical_Thickness_1621_PCL_Liquid ⁶		•	•	•	•																		
10. Cloud_Optical_Thickness_1621_PCL_Ice ⁷		•	•	•	•																		
11. Cloud_Effective_Radius_1621_PCL_Liquid		•	•	•	•																		
12. Cloud_Effective_Radius_1621_PCL_Ice		•	•	•	•																		



PARAMETER	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4) (Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)
13. Cloud_Water_Path_1621_PCL_Liquid	•	•	•	•			•			•										
14. Cloud_Water_Path_1621_PCL_Ice	•	•	•	•			•			•										
15. Cloud_Retrieval_Fraction_1621_PCL_Liquid								•	•											
16. Cloud_Retrieval_Fraction_1621_PCL_Ice								•	•											

(Supplementary 1.6 Retrieval)

01. Cloud_Optical_Thickness_16_Liquid	•	•	•	•						•										D
02. Cloud_Optical_Thickness_16_Ice	•	•	•	•						•										D
03. Cloud_Effective_Radius_16_Liquid	•	•	•	•			•			•					•			D	D	
04. Cloud_Effective_Radius_16_Ice	•	•	•	•			•			•					•			D	D	
05. Cloud_Water_Path_16_Liquid	•	•	•	•			•			•										
06. Cloud_Water_Path_16_Ice	•	•	•	•			•			•										
07. Cloud_Retrieval_Fraction_16_Liquid								•	•											
08. Cloud_Retrieval_Fraction_16_Ice								•	•											
09. Cloud_Optical_Thickness_16_PCL_Liquid	•	•	•	•						•										D
10. Cloud_Optical_Thickness_16_PCL_Ice	•	•	•	•						•										D
11. Cloud_Effective_Radius_16_PCL_Liquid	•	•	•	•			•			•					•			D	D	
12. Cloud_Effective_Radius_16_PCL_Ice	•	•	•	•			•			•					•			D	D	
13. Cloud_Water_Path_16_PCL_Liquid	•	•	•	•			•			•										
14. Cloud_Water_Path_16_PCL_Ice	•	•	•	•			•			•										
15. Cloud_Retrieval_Fraction_16_PCL_Liquid								•	•											
16. Cloud_Retrieval_Fraction_16_PCL_Ice								•	•											

(Supplementary 3.7 Retrieval)

Earth Observing System MODIS Atmosphere Level-3 Daily Product																						
PARAMETER	STATISTIC	Mean	Standard_Deviation	Minimum	Maximum	QA_Mean	QA_Standard_Deviation	Histogram_Counts (n)	Confidence_Histogram (4)	(Fraction)	Pixel_Counts	Mean_Uncertainty	Log_Mean_Uncertainty	Log_Mean	Log_Standard_Deviation	JHisto_vs_Opt_Depth (nxn)	JHisto_vs_Eff_Radius (nxn)	JHisto_vs_Eff_Radius_16 (nxn)	JHisto_vs_Eff_Radius_37 (nxn)	JHisto_vs_Temperature (nxn)	JHisto_vs_Emissivity (nxn)	JHisto_vs_Pressure (nxn)
		01. Cloud_Optical_Thickness_37_Liquid		•	•	•	•						•								D	
02. Cloud_Optical_Thickness_37_Ice		•	•	•	•						•								D			
03. Cloud_Effective_Radius_37_Liquid		•	•	•	•		•				•					•				D		
04. Cloud_Effective_Radius_37_Ice		•	•	•	•		•				•					•				D		
05. Cloud_Water_Path_37_Liquid		•	•	•	•		•				•											
06. Cloud_Water_Path_37_Ice		•	•	•	•		•				•											
07. Cloud_Retrieval_Fraction_37_Liquid										•	•											
08. Cloud_Retrieval_Fraction_37_Ice										•	•											
09. Cloud_Optical_Thickness_37_PCL_Liquid		•	•	•	•						•									D		
10. Cloud_Optical_Thickness_37_PCL_Ice		•	•	•	•						•									D		
11. Cloud_Effective_Radius_37_PCL_Liquid		•	•	•	•		•				•					•				D		
12. Cloud_Effective_Radius_37_PCL_Ice		•	•	•	•		•				•					•				D		
13. Cloud_Water_Path_37_PCL_Liquid		•	•	•	•		•				•											
14. Cloud_Water_Path_37_PCL_Ice		•	•	•	•		•				•											
15. Cloud_Retrieval_Fraction_37_PCL_Liquid										•	•											
16. Cloud_Retrieval_Fraction_37_PCL_Ice										•	•											

Derived from L2 Atm Profile (07_L2)

[Note: Low (Sfc-680 hPa) & High (440-10 hPa) def'n changed from C51 to C6]

01. Total_Ozone	•	•	•	•	•	•	•	•	•													
02. Total_Totals	•	•	•	•	•	•	•	•	•													
03. Lifted_Index	•	•	•	•	•	•	•	•	•													
04. Atmospheric_Water_Vapor	•	•	•	•	•	•	•	•	•													

Definition of "Daytime" (where COP retrieves and where CTP define "_Day" parameters)

Cloud Optical Properties:

COP "Daytime", where retrievals for clouds are made, is $\arccos(.15) = 81.3731^\circ$

So Cloud Optical Properties retrieves when Solar Zenith Angle $\leq 81.3731^\circ$

(Gala sometimes calls this SZA $< 81.4^\circ$)

Cloud Top Properties:

CTP "Daytime", where the CTP group retrieves and they append "_Day" to their parameters (SDS's) in L2, is SZA $\leq 85.0^\circ$.

So Cloud Top Properties calls things "_Day" in L2 when Solar Zenith Angle $\leq 85.0^\circ$

(Note: If you dump out the Solar_Zenith_Day SDS in L2, which is using the CTP definition of "daytime", you will see packed short integer values of 8500, but never 8501)

Upshot:

COP is 3.6269° more restrictive in the Solar Zenith Angle for their retrievals than the "_Day" CTP retrievals. (In other words, CTP extends a bit further into the low sun angle (twilight) regions than COP.)

81.3731° vs. 85.0°

Some April 4, 2014 notes on Cloud Optical Property parameters:

1. There are a number of new PCL (Partly Cloudy) Cloud Optical Property parameters.
2. The 1L and ML aggregation is only defined (currently) for the Primary 2.1 retrieval.
3. Only Liquid and Ice are aggregated for 1621, 16, and 37. Added some additional parameters for the Non-PCL case for symmetry.
4. Added Optical Thickness, Water_Path and Fractions for the **non-PCL** "_16" and "_37" cases for symmetry.

Some October 1, 2014 notes on Cloud Optical Property parameters:

1. COP Joint (2D) Histogram Count = 44 Joint Histograms
2. COP Marginal (1D) Histogram Count = 44 Marginal Histograms
3. Note the JH's highlighted in **Blue** are "jointed against" Re 1621 (So those JH's are: Tau1621 vs. Re1621)
There was not enough room in the SDS name to use "JHisto_vs_Eff_Radius_1621" in the Suffix Name with the long prefix name
4. In table above: **D = SDS's in D3 only (not in E3/M3)**
A total of 19 JointHistograms were deleted going from D3 to E3/M3 due to 2 GB uncompressed HDF file size limit in HDF4. There are also 14 scaler SDS's related to COP Fractions that are only in the D3 and not propagated to E3/M3 (due to it not being necessary).

Notes on Cloud_Fraction (from Cloud Mask):

In the L2 Cloud Fraction from Cloud Mask for daytime, stored in the 06_L2 SDS **Cloud_Fraction_Day**, there **ARE** non-zero fractions stored, which are less 16% (less than 4 out of 25 pixels). If you dump out the 06_L2 SDS Cloud_Fraction_Day, you will see the full range of possible cloud fraction numbers (in 4% increments) of: **0%, 4%, 8%, 12%**, 16%, 20%, 24%, ..., 92%, 96%, 100%. However only when the Cloud_Fraction is 16% or higher in a given 5x5 km L2 CTP grid cell (that is, at least 4 cloudy 1x1km pixels in the 5x5km (25 pixel) CTP retrieval grid) , will there be a CTP cloud retrieval performed. So if you find Cloud_Fraction_Day values of 0%, 4%, 8%, or 12%, in a particular 5x5 km L2 grid cell, you will find the SDS's Cloud_Top_Temperature, Cloud_Top_Pressure, etc, with a FILL VALUE (-9999). So it is possible to have a valid (non-zero) Cloud_Fraction_Day (4%, 8%, 12%) and a FILL (-9999) Cloud_Top_Pressure_Day, Cloud_Top_Temperature_Day, etc in the same 5x5 km grid cell.

At last count in October 2014, there were 88 Joint Histograms in the D3 file. (Fewer than that in the E3/M3)